^{14}O Lifetime Measurement as a Test of the Unitarity of the CKM Matrix

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The best experimental values of the effective weak vector coupling constant Gv come from measurements of the $0^+ \rightarrow 0^+$ superallowed Fermi beta decay. We are currently measuring the lifetime of ^{14}O to determine the V_{ud} element of the Cabbibo−Kobayashi−Maskawa (CKM) matrix relating the mass and weak eigenstates for quarks. Previous determinations of V_{ud} along with other measurements of V_{us} and V_{ub} have suggested that the CKM matrix is not unitary. This in turn has implications that contradict the standard model.

We measure the lifetime of ^{14}O which due to its 70.6 second lifetime has to be produced online at the 88" cyclotron with the $^{12}C(^3He,n)^{14}O$ reaction. A radioactive beam of ^{14}O, produced by IRIS (Ion Source for Radioactive Isotopes) is implanted into a thin Be foil. After loading the foil for 100 seconds a beam stop is inserted to ensure that no ^{14}O is implanted on the transfer mechanism. The foil is then transferred under vacuum to a detector system using a magnetically coupled pneumatic transfer arm. The positrons from the $^{14}O \rightarrow {}^{14}N + e^+ + \nu_e$ decay are then detected using two detector systems. Each detector consists of two thin ΔE plastic scintillators that operate in coincidence.

A trial run in December 2000 yielded promising results, see figure 1. Another run is scheduled for early spring with an expected 80 target loads at 1 million counts per loading will allow the lifetime to be measured to a precision of 10^{-4}.

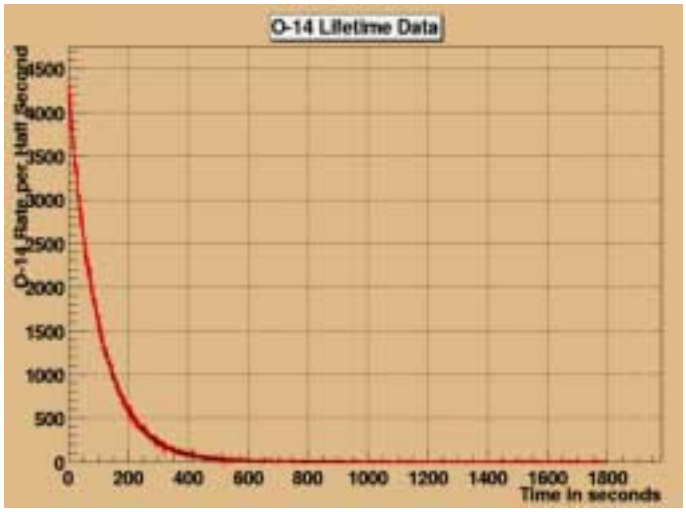

Fig. 1 A typical ^{14}O decay curve from the trial run in December 2000.

Footnotes
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